(E) ISSN: 3030-3214
Volume 3, № 1
2025

UDC: 666.622.7.553.532 10.70769/3030-3214.SRT.3.1.2025.8

SPECIFIC FEATURES OF BASALTS, ITS MELTING AND TEMPERING IN DIFFERENT ENVIRONMENTS

Sattorov Laziz Kholmurodovich
Docent Karshi engineering-economics institute, Karshi, Uzbekistan

Kurbanov Abdiraxim Axmedovich
Professor Bukhara engineering - technological institute, Bukhara, Uzbekistan

Nomozov Bakhtiyor Yuldashovich
Docent Karshi engineering-economics institute, Karshi, Uzbekistan

Juraeva Huriyat Zoirovna
Lecturer of the University of Economics and Pedagogy, Karshi, Uzbekistan

Abstract. *It is shown that a radical way to expand the possibility of obtaining metals from reserve, unused natural resources is one of the possible options for using local raw materials. This article presents the results of a scientific study devoted to the study of the specifics of the constituent elements contained. The results of the preparation and implementation of floating basalt works at the Asmansay-1 deposit are presented. metal-containing basalt minerals deposit "Asmansay-The results of melting basalts, their tempering in various environments were analyzed in order to find out the choice of optimal parameters for melting basalts and similar ores.*
Keywords: *basalt, thermodynamics, heating, pyroxene, crystalline fiber, filtering material, fiber, melting, dry processing.*

ОСОБЕННОСТИ БАЗАЛЬТОВ, ИХ ПЛАВЛЕНИЕ И ЗАКАЛКА В РАЗЛИЧНЫХ СРЕДАХ

Сатторов Лазиз Холмуродович
Доцент Каршинского инженерно-экономического института, Карши, Узбекистан

Курбанов Абдурахим Ахмедович
Профессор Бухарского инженерно-технологического института, Бухара, Узбекистан

Номозов Бахтиёр Юлдашович
Доцент Каршинского инженерно-экономического института, Карши, Узбекистан

Жураева Хурият Зоировна
Преподавателя Экономического и педагогического университета, Карши, Узбекистан

Аннотация. *Показано, что радикальный способ расширить возможности получения металлов из резервных, неиспользуемых природных ресурсов является одним из возможных вариантов использования местного сырья. В данной статье представлены результаты научного исследования, посвященного изучению специфики содержащихся в них составляющих элементов. Представлены результаты подготовки и осуществления плавучих базальтовых работ на месторождении Асмансай-1. Месторождение металлосодержащих базальтовых минералов "Асмансай" - Были проанализированы результаты плавки базальтов, их закалки в различных средах с целью выяснения выбора оптимальных параметров плавки базальтов и аналогичных руд.*
Ключевые слова: *базальт, термодинамика, нагрев, пироксен, кристаллическое волокно, фильтрующий материал, волокно, плавление, сухая обработка.*

BAZALTLARNING O'ZIGA XOS XUSUSIYATLARI, TURLI MUHITLARDA ERISHI VA TEMPERATURASI

(E) ISSN: 3030-3214
Volume 3, № 1
2025

Sattorov Laziz Xolmurodovich
Qarshi muhandislik-iqtisodiyot instituti dotsenti, Qarshi, O‘zbekiston

Kurbanov Abdiraxim Axmedovich
Professor Buxoro muhandislik-texnologiya instituti, Buxoro, O‘zbekiston

Nomozov Baxtiyor Yuldashovich
Qarshi muhandislik-iqtisodiyot instituti dotsenti, Qarshi, O‘zbekiston

Jo‘rayeva Huriyat Zoirovna
Iqtisodiyot va pedagogika universiteti o‘qituvchisi, Qarshi, O‘zbekiston

Annotatsiya. *Zaxiradagi, foydalanilmayotgan tabiiy resurslardan metallarni olish imkoniyatlarini kengaytirishning radikal usuli mahalliy xom ashyodan foydalanishning mumkin bo‘lgan variantlaridan biri ekanligi ko‘rsatilgan. Ushbu maqolada ular tarkibidagi elementlarning o‘ziga xos xususiyatlarini o‘rganishga bag‘ishlangan ilmiy tadqiqot natijalari keltirilgan. Asmansoy-1 konida suzuvchi bazalt ishlarini tayyorlash va amalga oshirish natijalari taqdim etilgan. Tarkibida metall bo‘lgan “Asmansoy” bazalt minerallari koni - Bazalt va shunga o‘xshash rudalarni eritishning optimal parametrlarini tanlash maqsadida bazaltlarni eritish, ularni turli muhitlarda toblash natijalari tahlil qilindi.*
Kalit so‘zlar. *bazalt, termodinamika, qizdirish, piroksen, kristall tola, filtrlovchi material, tola, eritish, quritib ishlov berish.*

Introduction. A study of the technological processes of basalt processing enterprises in Uzbekistan showed a lack of experience in organizing stone casting for petrurgical production. The reason for this phenomenon can be considered to be insufficient knowledge of the basalt melt: the processes of draining the liquid mass into the mold of the flask and the further state of the product associated with firing, as well as the lack of information about production costs and payback periods. In this regard, based on foreign experience, the need for an experimental study of the possibility of creating stone casting technology has been identified. Since the difference in the chemical-mineralogical composition of the basalt rock in the deposits of Uzbekistan and the melting temperature of basalts did not allow direct introduction of foreign technology into production, conditions were created in the laboratory to study the behavior of the cast form of basalts after melting and tempering in different environments.

Literature analysis and methods. To conduct experimental studies, the following types of work were performed:

- the material chosen for the manufacture of the mold of the flask is 2ХП-3 brand refractory brick, the holding temperature of which reaches 2500 0C;

- three holes were drilled on the side of the brick with a diameter of 10; 14 and 16 mm, which was argued by the arbitrariness of the choice of hole sizes depending on the thickness of the walls of the flask [1,2];

- the flasks are prepared for work;

- so that when the rock is heated and the liquid mass is poured into the mold, no bubbles remain inside the workpiece, three through holes with a diameter of 3÷5 mm are drilled to allow air to pass through and remove gas bubbles from the mass. The channels of the holes were directed upward at such an angle that during the process of pouring the liquid mass into the holes of the flask, impurity gases freely passed into the open space;

- prepared a laboratory oven. The oven temperature was measured using an electronic thermometer. When the test heating of the furnace reached a temperature of 1000 °C, the furnace was turned off. The furnace was cooled until room temperature was reached and the furnace was loaded with flasks.

The process of smelting basalt rock was observed through the window of the furnace door. Three such flasks were made for the purpose of tempering the cast mold in the open air, at room temperature and at high temperature (800÷850 0C). When the temperature reached 1550 °C, the furnace was turned off, the door was opened and two of the three flasks were removed from the furnace using traditional metal tongs used in the foundries of the Navoi Machine-Building Plant.

The first flask was left in the furnace with the doors open to temper the molten basalt inside the furnace. The second flask was kept outside in the open air to cool the workpiece to atmospheric temperature. The third flask was kept in laboratory conditions to room temperature. Then the ceramic bands used to separate the flasks were removed and the cooled blanks were taken out.

(E) ISSN: 3030-3214
Volume 3, № 1
2025

The results showed that the cooling of the workpiece that was in the furnace was slow. In the other two conditions, the cooling process of the workpieces occurred faster and almost equally, since the ambient temperature was 23 °C.

It is necessary to note another characteristic feature of cast basalt in a flask, which was kept in a furnace until completely cooled and had an almost smooth outer surface. Bubbles and small cracks were observed on the outer surface of the remaining two workpieces. It was established that the basalt melt, which was in the flask at a high positive temperature for a relatively longer time, to some extent went through the stage of additional "firing-homogenization". This similarity of "annealing" can be found in the production of electrical insulators of different potentials. In general, it was found that cast basalt after annealing will have high hardness and a smooth surface. Parameters such as "time", "temperature", "melting rate" and "annealing" are interrelated and product performance largely depends on these parameters. Product quality depends on the annealing temperature, tempering temperature or cooling temperature gradient.

Processing of basalts using the petrurgical method for the manufacture of parts for a fleet of machines for various purposes. In mechanical engineering of any branch of the national economy, an important place is given to strength indicators and technological parameters, which depend on the durability of the materials used. Therefore, when designing machine parts, for example, in the oil and gas industry, special attention is paid to shock loads, operational properties, heat resistance, corrosion resistance, maximum vibration force, etc. This dissertation analyzes the results of a study of the characteristic indicators of metals that are extracted from basalts of the Asmansay-1 deposit. The study of the Asmansay-1 minerals is argued by the fact that in the rock composition of the bottom deposit, for example, the content of iron oxides reaches up to 15% or more [3].

Results and discussions. Study and analysis of technical literature and patent sources showed that they do not contain information about the content and extraction of metals from basalt rock. Considering the urgent need of the country's industry for raw materials for the production of metals, it can be assumed that basalt minerals with natural and technical characteristics can be a promising mineral raw material base for the production of metals. For this purpose, an experimental study was organized to determine the content of metals in metal samples. Samples of these metals were removed from unauthorized liquids that were simultaneously released from the furnace, where the process of melting basalt rock and forming crystalline fibers took place.

After which the metal samples were subjected to preliminary chemical analysis using a well-known method. The results are shown in Table 1. The experiment was carried out on 10 kilograms of basalt minerals "Asmansay-1", which contains the maximum amount of FeO and Fe_2O_3, up to 18÷ 20% [4].

Table 1

Results of experimental studies. Chemical composition of the material PF2 and PF3

Si (в kg)	Mn (в kg)	S (в kg)	P (в kg)	As (в kg)
0.5 - 0.9	до 2	до 0.07	0.3 - 2	до 0.2
Chemical composition of the PF3 material				
Si (в kg)	Mn (в kg)	S (в kg)	P (в kg)	As (в kg)
до 0.5	до 2	до 0.07	0.3 - 2	до 0.2

Tabular data show that samples of by-products (hereinafter referred to as metal) contain "ultimate phosphorous cast iron intended for further processing into steel or remelting in iron foundries for the production of castings," which ultimate phosphorous cast iron is intended for further processing into steel or remelting in iron foundries in the production of castings. The latter indicates that if the appropriate technology is developed, a promising direction will open up for the production of metals from local basalt rock.

It has been established that the best natural raw materials for basalt stone casting are igneous rocks, which include: diabases, basalts, andesite-basalts, gabbro-diabases and metamorphic and sedimentary rocks close to them in gross chemical composition: shales, amphibolites, clays, sands etc.

In practice, it has been proven that the best casting properties are found in melts whose chemical composition is as follows (in%): SiO_2 −43.5÷49.0; $A1_2O_3$ −11.0÷20.0; CaO −9.0÷16.0; MgO −5.0÷11.0; FeO −2.0÷7.0; (Na_2O+K_2O) 1.2÷5, which proves the acceptability of manufacturing cast products from basalts [5,6].

(E) ISSN: 3030-3214
Volume 3, № 1
2025

Preliminary studies of the chemical and mineralogical composition of the basalt rock of the Asmansay-1 deposits showed on average the following composition of chemical components, (in%): SiO_2 −43.5÷53.4; $A1_2O_3$ −9.2÷15.74; CaO−5.42÷15.8; MgO−1.1÷5.44; FeO−1.16÷8.9; Fe_2O_3−2.89÷7.37; (Na_2O+K_2O) −1.39÷3.5, which are suitable for smelting and extraction of associated metal.

One of the characteristic indicators of the products extracted from Asmansay-1 basalts is their physical and mechanical properties and the properties of cast basalt, which manifest themselves when exposed to external loads. In general, the behavior of a recovered cast by-product under load consists of three sequential and often overlapping processes: a) reversible or elastic deformation, consisting of a conditionally instantaneous part and an elastic aftereffect; b) plastic deformation; and destruction.

The state of the associated metal extracted from cast basalt during transitions is called critical or limiting. Knowledge of the behavior of basalt cast metal at each stage of deformation, as well as the conditions of transition from one stage of deformation to another during the creation of a piece of unauthorized extracted metal, is of great practical importance, since it allows one to predict the behavior of the metal or alloy under pressure from the structure.

The physical and mechanical properties of basalt associated cast products are divided into deformation, strength and rheological. Deformation properties characterize the behavior of associated metals under loads that do not exceed critical loads and, therefore, do not lead to destruction. These properties can be expressed by two pairs of indicators: either the deformation modulus and Poisson's ratio, or the shear and volumetric compression moduli.

The deformation properties of the associated extracted cast basalt metal are determined under conditions that simulate the operation of the product in question in possibly the oil and gas industry. The study showed that the deformation properties of metallic samples are most often determined during static rewarding. However, for the design of equipment, for example a drilling rig, the study of the deformation properties of soils is also under the influence of vibration, variable loads, etc. [7,8].

Particularly characteristic is the fact that metals incidentally extracted from basalt minerals, when operating under load, can be deformed with free expansion, limited lateral or without lateral expansion. This is evidenced by the results of experimental studies obtained at research stands. The first condition is realized during uniaxial compression of the samples, the second - when tested in triaxial compression devices and by the test load method, the third - during compression.

Another practically and theoretically important indicator is that strength properties characterize the behavior of cast basalt metal under loads equal to or exceeding critical loads, and are determined only when the soil is destroyed. Shear and rupture are the two main mechanisms by which a body loses strength. The shift occurs under the influence of tangential forces; When shearing, one part of the body moves relative to another. Body rupture occurs under the influence of normal tensile forces and is morphologically expressed in the form of cracks and separation of one part of the body from another. The main indicator of the strength of cast basalt metal is their shear strength; tensile strength is determined much less frequently. In the practice of geotechnical surveys, the resistance of soils to uniaxial compression is often determined. [8,9]. Another important factor may be the loss of strength of the soil mass, which can occur as a result of plastic deformations reminiscent of the flow of viscous metallic liquids. Therefore, cast metal from basalt is also characterized by viscosity, which allows one to evaluate the magnitude of plastic deformations under a given force over a long period of time. For example, in such slow deformations are centuries-old sediments and the origin of the mineral and its components, the movement of metal parts to each other during operation, etc. The formation of folding and possible bending of dimensional parts is also the result of their flow under prolonged action of forces. As a result, research and analysis of indicators made it possible to identify the physical mechanism of creep of metals, which is an inherent characteristic of the material and is considered to be very complex and depends on a large number of factors. In crystals, creep is caused by the movement of structural defects, twinning, translation, and diffusion; in polycrystalline bodies and dispersed

(E) ISSN: 3030-3214
Volume 3, № 1
2025

clay soils that creep at lower pressures than crystals - quasi-viscous sliding of particles relative to each other, reorientation of particles in the direction normal to the resulting stress, and the development of microcracks. In practice, there is such an expression as “creep kinetics”, which depends on pressure and temperature and is complicated by various structural transformations - compaction, structural changes and hardening of metals at the cooling stage and dilatancy softening at the stage of lava flow of liquid metals [10,11,12].

Conclusion. It was revealed that in order to compile the obtained data, for example, on the creep of newly produced metal parts, it is necessary to know two quantities - the creep threshold and the effective viscosity coefficient of the body of a metal product and its change over time. In mechanics, for the ease of transmitting information and clarifying opinions on this matter, the expression “Creep threshold” (according to N.N. Maslov) has been introduced, which is a tangential stress at which and above which the creep deformation, which previously had a magnitude and speed of almost neglected character is sharply intensified.

The creep threshold of the structural components of metal products depends on the structure and composition of the metal, on temperature and pressure and the speed of pressure. And for dense rocks, the threshold for creep may be higher than for low-density rocks.

The “creep threshold” is determined based on data from long-term creep experiments of identical samples, in our case, simultaneously extracted metal samples tested at different values of shear stress. [13,14,15,16].

Thus, the study and analysis of the research results, the specific features of associated metal samples extracted from melting basalt minerals, showed that the natural subsoil of our republic can produce metals from local raw materials.

However, practically it is very important that in all spheres of industry of the national economy, the quality of products produced and the satisfaction of consumer demand of producers and consumers largely depends on the quality of the raw materials used. In our case, basalt rocks from the Asmansay-1 deposit are recommended as raw materials. In this case, we limited ourselves to considering only the issue of extracting metals and alloys from local basalt minerals that have good prospects.

REFERENCES

1. L.Kh.Sattorov, A.A.Kurbanov, Zh.Kh.Rakhmonov, Processes of filtration of industrial gases from dust through basalt filters, Bulletin of the Tula State University Automation: problems, ideas, solutions, Tula, APIR-20, 205-210 (2015)
2. L.Kh.Sattorov, A.A.Kurbonov, About the advantages of basalt filter materials, International Scientific and Technical Conference Mining and metallurgical complex achievements, problems and current development trends - Navoi, 134 (2015)
3. N.F.Drobot, O.A.Noskova, A.V.Steblevskii, Use of Chemical and Metallurgical Methods for Processing of Gabbro-Basalt Raw Material, Theoretical Foundations of Chemical Engineering, 47, 4, 484-488 (2013)
4. D.E.Morkovkin, D.S.Lopatkin, T.N. Shushunova, B.K. Sharipov, A.A. Gibadullin, Journal of Physics: Conference Series, 1515(3), 032002 (2020)
5. A.Panchenko, A.Voloshina, S.S.Sadullozoda, O.Boltyansky, V.Panina. Lecture Notes in Mechanical Engineering, 101–111 (2022)
6. A.M.Ermakova, IOP Conference Series: Earth and Environmental Science, 1045, 012123 (2022)
7. V.A.Kovshov, Z.A.Zalilova, M.T.Lukyanova, E.F.Sagadeeva, Lecture Notes in Networks and Systems, 205, 595-603 (2021)
8. B.S.Kamolov, A.A.Kurbanov, L.Kh.Sattorov E3S Web of Conferences 411, 01036 (2023). Features of filtration of industrial gases from dust with a basalt filter. APEC-VI-2023
9. A.Kurbonov, L.Sattorov, B.Kamolov BIO Web of Conferences, 02 (2023) O.Rakhimov Chemical and mineralogical studies of basalt “Aydarkul”. CIBTA 2023.

(E) ISSN: 3030-3214
Volume 3, № 1
2025

10. Velde K., Kiekens P., Van Langenhove L. Basalt fibers as reinforcement for composites // Van de Department of Textiles, Ghent University, Technology park. B-9052 Zwijnaarde, Belgium.- 2007. 907p.
11. Анализ минерального сырья. Ред. Книпович Ю.Н., Морачевский Ю.В. Л. ГХИ. 1056 С.
12. Джеффери П. Химические методы анализа горных пород. М. Мир.1973. С.470.